*International Journal of Instruction*
*e-ISSN: 1308-1470 ● www.e-iji.net*

*April 2022 ● Vol.15, No.2*
*p-ISSN: 1694-609X*
*pp. 455-472*

Article submission code: 20210417033054

Received: 17/04/2021
Revision: 25/10/2021

Accepted: 16/11/2021
OnlineFirst: 09/02/2022

# The Effectiveness of Problem-based learning with Local Wisdom oriented to Socio-Scientific Issues

**Silvi Puspa Widya Lubis**
Ph.D Student, Yogyakarta State University, Indonesia, *silvi_lubis.2017@student.uny.ac.id*

**I Gusti Putu Suryadarma**
Prof. Dr. Yogyakarta State University, Indonesia, *samodhaya@yahoo.com*

**Paidi**
Prof. Dr. Yogyakarta State University, Indonesia, *paidi@uny.ac.id*

**Bagus Endri Yanto**
Dr. Faculty of Tarbiyah and Tadris, State Islamic Institute of Bengkulu, Indonesia, *Bagus@iainbengkulu.ac.id*

The research aimed to know the effectiveness of problem-based learning combined with local wisdom in Acehnese called Hukum Adat Laôt. The local wisdom is oriented to socio-scientific issues to improving conceptual knowledge and environmental literacy. This study adopted a quasi-experimental with pretest-posttest control group design. In the experimental class, treatment was given using the problem-based learning model with local wisdom oriented to socio-scientific issues. In contrast, the control class was given by applying traditional learning. The population used in this study were all high school students in Aceh Besar, Indonesia. A cluster sampling technique is applied to obtain 54 students from the 2019/2020 academic year as samples. Data collection uses a test instrument conceptual knowledge and environmental literacy validated based on the Aiken index. Meanwhile, the instrument reliability is determined based on Cronbach's alpha coefficient. The data were analyzed by using Manova. The results indicate significant differences in the mean scores of the results related to conceptual knowledge and environmental literacy. The conclusion states that applying problem-based learning with local wisdom oriented to socio-scientific issues significantly impacts students' conceptual knowledge and environmental literacy.

Keywords: problem-based learning, local wisdom, socio-scientific issues, environmental literacy, conceptual knowledge

**Citation:** Lubis, S. P. W., Suryadarma, I. G. P., Paidi., & Yanto, B. E. (2022). The effectiveness of problem-based learning with local wisdom oriented to socio-scientific issues. *International Journal of Instruction*, *15*(2), 455-472. https://doi.org/10.29333/iji.2022.15225a

## INTRODUCTION

The demands of 21st-century education require teachers to empower students' critical and creative thinking skills to face this era. Education prioritizes aspects of mastery of science and technology and prioritizes thinking skills and competitiveness to create an education system that is matched and in line with global demands (Akmal, 2019). Critical thinking is an ability that students must obtain (Sihombing et al., 2018). Thinking skills instilled through concepts enables students to build learners' cognitive metaphors (Mustofa & Hidayah, 2020). A teacher must be able to develop Pedagogical Content Knowledge (PCK) in the learning process so that it helps students to explore deeper topics based on ideas or concepts that lead to a higher level of complexity (Hapsari et al., 2019; Nachreiner et al., 2015). Students certainly have different ways of understanding a concept (Arisjanti et al., 2014).

Conceptual knowledge is built in different ways based on the level of students' ability. According to Arisjanti et al., (2014), knowledge is produced in several ways, namely: 1) students get knowledge from teachers and peers; 2) re-reading the subject matter; 3) doing practice questions; 4) classifying the teaching materials and 5) taking courses outside of school. However, the findings in the field during the preliminary study ere that only 12.46% of students who mastered conceptual knowledge skills were still in the low category. Furthermore, research results from Adlim et al., (2017), and Ilhami et al., (2019) stated that the conceptual knowledge skills of students were still low. The results show that the process of building conceptual knowledge is challenging. It is caused by many concepts that are primarily used in everyday life have different meanings when used in formal settings (Hestiana & Rosana, 2020). Therefore, it is necessary to understand the sense of building knowledge and how to build concepts in the learning process to comprehend conceptual knowledge correspondingly (Paidi et al., 2020).

One of the achievements of science learning is building conceptual knowledge and improving scientific literacy (Wahyu et al., 2020). Scientific literacy includes health issues, environment, and socio-scientific relationships (Saribas, 2015). Furthermore, environmental literacy intersects with scientific literacy (Saribas, 2015; Kaya & Elster, 2018). The need for environmental literacy makes environmental education significant to be applied in schools (Dahliani et al., 2015; Febriasari & Supriatna, 2017). But in reality, many schools have not implemented environmental education yet. Thus, students do not master environmental literacy hierarchically (Singleton, 2016). Environmental literacy is a skill needed as a fundamental function of education in providing basic knowledge, skills, and motivation to maintain, restore or increase contributions to the environment (Febriasari & Supriatna, 2017). Students who master environmental literacy are claimed to be environmentally literate people, namely people who can investigate, evaluate, and apply environmental issues to understand, determine and take appropriate actions. As a result, students' mindsets are formed to solve the environmental problems raised in the community (Tivani & Paidi, 2016; Nasution, 2016).

Students build environmental literacy by emphasizing the knowledge aspect and the ability to think effectively and environmentally responsible behaviour (Saribas, 2015;

Komariah et al., 2017). Thus, students have competencies in building a sense of caring for the environment and maintaining existing natural resources (Safitri et al., 2020). However, the reality in the field during the preliminary study shows that only 23.2% of students have mastered environmental literacy, and it is still in the low category. Furthermore, the results of research from Prasetiyo (2017) and Farwati et al. (2017) also stated that students' level of environmental literacy was still low. It reflected that there are many obstacles in building environmental literacy, including limitations of learning devices, material that is not matched with the design curriculum, and limited learning resources and relevant learning media (Veisi et al., 2018; Fidan & Ay, 2016).

The learning process in the classroom requires a learning model that optimizing the students' mastery of conceptual knowledge and environmental literacy. The appropriate learning model to be applied is a model that is based on a constructivist approach (Simanjuntak et al., 2021). It is the problem-based learning model (Siew et al., 2015). Problem-based learning is applied in schools because it encourages students to actively build a knowledge-based experience and improve their ability to regulate questions (Gewurzt et al., 2016; Mustofa & Hidayah, 2020). Abbey et al. (2016) suggests that problem-based learning develops positive attitudes and social attitudes, helping students acquire valuable knowledge and skills. According to Rizkita et al., (2016) students make a strong relationship between the concepts and facts learned. It reflects students actively collaborating to find information, not only as passive learners who only receive information

However, there are weaknesses in this learning model. Problem-based learning is incapacitated in increasing students' conceptual knowledge (Shisigu et al., 2018). therefore problem-based learning requires students to be involved in conceptual analysis, not only in solving problems (Simone, 2014; Simanjuntak et al., 2021). Thus, this study needs to add learning steps to problem-based learning to cover existing deficiencies to improve conceptual knowledge and environmental literacy on ecosystems. Learning ecosystem materials can be done by going directly to the field and integrating local cultural knowledge. The use of local wisdom as a learning resource protects local cultural knowledge and helps students through real-world learning (Khusniati et al., 2017). The learning process based on local culture and local wisdom makes it easier for students to understand the competencies in learning. Culture can be linked to carrying out the learning process (Ramdiah et al., 2020).

Aceh Province, Indonesia, has local wisdom that potentially supports ecosystem learning, namely Hukum adat Laôt, which has not been optimally utilized in learning Biology. If it is potentially explored and appropriately packaged, it further becomes a learning model that improves students' conceptual knowledge and environmental literacy. Hukum adat Laôt is a set of unwritten provisions that live and develop in Acehnese society (Nangroe Aceh Darussalam, 2008). Hukum adat Laôt in Aceh is customary law that applies to coastal communities in their respective traditional territories (Abdullah et al., 2015). Hukum adat Laôt can be used to develop problem-based learning for teaching ecosystem concepts in high schools. Activities in traditional law can be used as learning steps to overcome the shortcomings of problem-based

learning. The learning process adopted with Hukum adat Laôt can also improve cognitive, affective and environmental awareness skills (Aswita, 2020). Problem-based learning still needs other parts to overcome the existing shortcomings, namely by using socio-scientific issues.

Socio-scientific issues (SSI) provide the contextual learning situation required by problem-based learning. It provides opportunities for the development of scientific skills, exploration of moral problems, the development of moral reasoning, and the ability to reflect reflective judgment (Zeidler et al., 2019; Altan et al., 2018). Students can make decisions on problems that exist in their social environment scientifically, which have social value. Socio-scientific issues encourage the involvement of students through social problems that are relevant and rooted in scientific disciplines. As a result, it potentially minimizes classroom management issues and opportunities in the scientific context (Arantes do Amaral & Fregni, 2021). This is in line with the previous study results by Subiantoro et al., (2013). It revealed that socio-scientific issues meet the needs of learning contextuality and positively affect student learning outcomes. Socio-scientific issues also support exploring social-ethical values personally and in groups (Aisya et al., 2016).

This study focused on applying the problem-based learning model combined with local wisdom (hukum adat laôt) oriented to socio-scientific issues on the conceptual knowledge and environmental literacy of senior high school students in Aceh. Based on previous research studies, this study aims to continue the shortcomings by developing a problem-based learning model combined with local wisdom (hukum adat Laôt) oriented to socio-scientific issues for conceptual knowledge and environmental literacy of students in Aceh. Based on the background description and problems formulated above, this study focuses on implementing the problem-based learning model combined with local wisdom (hukum adat laôt) oriented to socio-scientific issues on the conceptual knowledge and environmental literacy of senior high school students in Aceh. Thus, the research question is how the effectiveness of the implementation of the problem-based learning model combined with local wisdom (hukum adat laôt) oriented socio-scientific issues on the conceptual knowledge and environmental literacy of senior high school students in Aceh.

## METHOD

### Research Design

This research investigated the effectiveness of the implementation of problem-based learning combined with local wisdom (hukum adat laôt) oriented to socio-scientific issues on the conceptual knowledge and environmental literacy of senior high school students in Aceh. This study applied a quasi-experimental with pretest-posttest control group design to compare the improvement in conceptual knowledge and environmental literacy between the experimental class and the control class. The experimental class was given treatment using problem-based learning with local wisdom (hukum adat laôt) oriented to socio-scientific issues, while the control class applying the traditional learning model. This research has been conducted for two months, starting from October

to December 2020. In using the problem-based learning with local wisdom (hukum adat laôt) oriented to socio-scientific issues, some stages of learning activities were applied, the brief syntax is presented in table 1 below.

Table 1
Syntax of problem-based learning (Topic Ecosystem) with local wisdom (Hukum Adat Laôt) oriented to socio-scientific issues

| No | Learning steps | Teacher's activities | Students' activities | Place |
|---|---|---|---|---|
| 1 | Introduction | Pray altogether<br>Inform theme, sub-theme, indicators, and learning goal.<br>Do apperception activities through presenting local wisdom of *Panglima laot* customary law and provides opening questions | Pray altogether<br>Listen carefully to themes, sub-themes, indicators and learning objectives and answer questions. | In the classroom |
| 2 | Orientation (explaining and motivating students) | Play videos related to socio-scientific issues of the marine ecosystem as a problem<br>Explain learning topics and direct students to pay attention to video shows. | Take attention to the teacher's explanation and noted issues related to marine ecosystems | In the classroom |
| 3 | Collaboration (organize students to complete group assignments) | Organize and define student learning tasks related to these problems according to the group<br>Facilitate students in carrying out discussions in groups<br>Ask students to analyze the impact of video impressions | Students sit according to their respective groups<br>Students actively carry out discussions in their respective groups<br>Actively discussing either in groups or between groups | In the classroom |
| 4 | Exploration | The teacher explains the phenomena that occur in society | Find phenomena that appear in the environment | In the classroom |
| 5 | Making meaning | The teacher guides students to conclude temporary answers<br>Ask students to find information via the internet, | Students make temporary answers | In the classroom |
| 6 | Investigation (investigation by recording or recording the facts of conducting reviews, experiments) | Guide students to do field practice about marine ecosystems<br>Ask students to conduct interviews with *Panglima Laot* to clarify issues related to SSI<br>Help students plan and prepare appropriate work such as reports, videos, and models and help them to share assignments with their friends | Does field practice<br>Conducting interviews with *Panglima Laot*<br>Processing the data and information obtained | Out of the classroom |
| 7 | Findings presentation (discussing the findings) | Guide students to present the results of the investigation<br>Facilitate students in carrying out presentations | Active in presenting the results of the interview<br>Learners actively explore information | In the classroom<br>- |
| 8 | *Evaluation* (evaluate students' presentation) | Facilitate students to reflect<br>Provide opportunities for students to ask questions<br>Provide feedback<br>Ask students to analyze the results of other groups' presentations<br>Evaluate the results of solving the problem yourself | Analyze the results of other groups' presentations<br>Evaluate the results of problem-solving<br>Actively working on and solving existing problems<br>Actively asking questions about concepts that have not been understood | In the classroom |
| 9 | *Closing* | Guide students to conclude the learning topic<br>Stimulate motivation through emphasizing local wisdom and moral messages<br>Guide students to pray together | Actively concluding learning guided by the teacher<br>Convey an impression of the learning that has been done | In the classroom |

**Data Collection and Analysis**

The population in this study were all senior high school students in Aceh Besar, Indonesia. The research sample consisted of 54 senior high schools in the Academic Year 2020/2021. The subjects of this study were teachers and students of senior high school in Aceh Besar. This location was chosen because Aceh Besar is a coastal area where the local social and cultural life of the community is still bound by customary regulations and there is a customary government structure. There were 27 students in each experimental and control group. The sampling technique in this study used cluster sampling because the sample members of the population were larger, so the samples were taken based on predetermined groups (Sugiono, 2015). In a consideration of large population and its pertinent region characteristics, cluster sampling is adopted to appropriately select research random participants, moreover it provides equal opportunities for each member of the population selected to be the research sample. Data collection was carried out using conceptual knowledge and environmental literacy test instruments. The test instrument is in the form of multiple-choice questions (15 items conceptual knowledge test and 15 items environmental literacy test). This question is arranged based on the indicators for each component with a rating scale of 0-1, a rating scale of 1 for correct answers and 0 for wrong answers. This test was given to students before learning (pretest) and after learning (posttest). The following is the instrument grid that is used to obtain environmental literacy data in Table 2 and the conceptual knowledge test instrument grid in Table 3 below.

Tabel 2
Environmental literacy instrument grid

| Learning aspects | Specific components | Indicator | Item |
|---|---|---|---|
| Ecological know*ledge* | Ecosystem structure | Identify basic ecosystem concepts<br>Identifying the structure of the ecosystem | 1, 3, |
| | Ecosystem functions | Identify the interaction patterns of living things<br>Describe the material cycle<br>Describe the flow of energy<br>Analyze the process of environmental change by the influence of organism | 7, 14 |
| Cognitive skill | The identification of environmental issues | Identify environmental issues<br>Describe issues related to the environment | 2, 11 |
| | Analysis of environmental issues | Analyze ecological knowledge | 4, 5, |
| | Designing a solution to the problem | Provide environmental solutions<br>Apply knowledge to find solutions to problems | 15 |
| Environmental affect | verbal commitment, | Caring attitude towards the environment<br>Design solutions and prevention of new problems | 6 |
| | Sensitivity related to the environmental issues | Have environmental sensitivity | 9, 12 |
| | personal responsibility | have a personal responsibility towards the environment | 8 |
| | does an action on environmental issues | Have the motivation to act on environmental issues | 10 |
| Behavior | A substantial commitment to do action | Carry out activities related to the environment<br>Be directly involved in solving and preventing environmental issues. | 13 |

Table 3
Conceptual knowledge instrument grid

| Components of knowledge | Learning aspects | Indicator | Item |
|---|---|---|---|
| knowledge of classifications and categories | Know the concepts and phenomena | Identify the components of the ecosystem<br>Describe the ecosystem problems in *laot* customary law | 1, 14, |
| | Classify Object | Identify the components of an ecosystem<br>Identify the living units that make up the ecosystem | 2, 3 |
| | Provide example | Describe ecosystem types | 6, 8 |
| knowledge of principles and generalizations | Identify object | Identify interactions between ecosystem components | 7, |
| | Events / develop the conditions of a concept | Describe the interaction between ecosystem components in the sea (*laot)* customary law<br>Describe the occurrence of interaction patterns in the ecosystem<br>Describe the role of biotic components in food chains and food webs | 5, 9 |
| | Determine the relationship between events and facts | Communicate the role of producers and consumers in food chains and webs | 4, 12 |
| knowledge of theories, models and structures | Describe a theory | Describe the theory of ecosystems<br>Describe the theory of the sea *laot* customary law | 10 |
| | Understand, explain and predict a problem based on the theory | Describe the relationship between the interactions between ecosystem components in the biogeochemical cycle | 13, 15 |
| | Apply theories and structures to suit new circumstances | Conclude that in nature, if there is an imbalance of ecosystem components, rehabilitation efforts must be made so that the balance of the process can take place | 11 |

This research instrument has been validated by three educational experts. Proving the validity of the instrument is done by measuring the expert agreement index based on the Aiken index (V). The results of these measurements are presented in Table 4 below:

Table 4
Results of the Aiken index coefficient of instrument validity conceptual knowledge and environmental literacy

| Conceptual knowledge | | |
|---|---|---|
| Item | V | Description |
| 1 | 0.80 | Valid |
| 2 | 0.70 | Valid |
| 3 | 0.80 | Valid |
| 4 | 0.80 | Valid |
| 5 | 0.75 | Valid |
| 6 | 0.75 | Valid |
| 7 | 0.75 | Valid |
| 8 | 0.85 | Valid |
| 9 | 0.85 | Valid |
| 10 | 0.85 | Valid |
| 11 | 0.80 | Valid |
| 12 | 0.80 | Valid |
| 13 | 0.85 | Valid |
| 14 | 0.70 | Valid |
| 15 | 0.80 | Valid |
| Environmental literacy | | |
| Item | V | Description |
| 1 | 0.85 | Valid |
| 2 | 0.75 | Valid |
| 3 | 0.85 | Valid |
| 4 | 0.85 | Valid |
| 5 | 0.80 | Valid |
| 6 | 0.80 | Valid |
| 7 | 0.75 | Valid |
| 8 | 0.75 | Valid |
| 9 | 0.85 | Valid |
| 10 | 0.85 | Valid |
| 11 | 0.80 | Valid |
| 12 | 0.80 | Valid |
| 13 | 0.85 | Valid |
| 14 | 0.85 | Valid |
| 15 | 0.75 | Valid |

Instrument reliability is determined based on Cronbach's Alpha coefficient. The reliability of the conceptual knowledge test instrument was 0.86, while the reliability of the environmental literacy instrument was 0.89, thus the instrument reliability value was in a high category (Taber, 2018). The results of this study were analyzed using quantitative descriptive with the Statistical Package for Social Sciences (SPSS) for Windows version 22. To determine the normality of the data with the Shapiro Wilk test and to check variances homogeneity, the Levene test was performed. Furthermore, the Manova was conducted to determine significant differences in the mean scores of the applied experimental class and control class.

**FINDINGS**

The achievement of the effectiveness of the problem-based learning model combined with local wisdom (hukum adat laôt) oriented to socio-scientific issues is determined based on the impact of using the model on conceptual knowledge and environmental literacy. The use of the problem-based learning model with local wisdom (hukum adat laôt) oriented to socio-scientific issues is claimed effective if it improves conceptual knowledge and environmental literacy. The results of this pre-test are the normality test and the homogeneity test. The significance value of the normality test was determined based on the Shapiro Wilk test. The test value for the normality test of the experimental class is 0.134, the control class is 0.241, the two significance values are more than 0.05. Thus, it is concluded that the test data used is normally distributed. Furthermore, based on the difference in the average score between the experimental class and the control class based on table 5, it shows that in the experimental class the average environmental literacy ability was obtained 83,555 and conceptual knowledge was obtained 84.555, both of which were higher than the average value in the control class.

Table 5
Comparison of average value of environmental literacy and conceptual knowledge control and experiment class

| | Group | Mean | Std. Deviation | N |
|---|---|---|---|---|
| Environmental literacy | Control | 74.0370 | 2.37748 | 27 |
| | Experiment | 83.5556 | 2.04438 | 27 |
| | Sum | 78.7963 | 5.28215 | 54 |
| Conceptual knowledge | Control | 74.1111 | 2.15430 | 27 |
| | Experiment | 84.5556 | 3.02977 | 27 |
| | Sum | 79.3333 | 5.87929 | 54 |

Based on the results of the homogeneity test, it can be calculated that each dependent variable has the same variance in each group because the significant value is 0.319 (p-value > 0.05). It is also assumed that the correlation between the dependent variables is the same in all groups (see table 6).

Table 6
Box's test of equality of covariance matrices[a]

| | |
|---|---|
| Box's M | 3.663 |
| F | 1.170 |
| df1 | 3 |
| df2 | 486720.000 |
| Sig. | .319 |

Table 7 presents the results of Manova using Hotelling's Trace statistics. This test statistic is suitable if there are only two groups of independent variables. The higher the Hotelling's trace statistical value, the greater the influence of the problem-based learning model with local wisdom orientated to socio-scientific issues, based on Hotelling's trace value table, it was obtained 8,398 greater than the Pillai's trace value (hotelling's trace > Pillai's trace value).

Table 7
Multivariate tests

| Effect | | Value | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|
| Intercept | Pillai's Trace | 1.000 | 54456.050[b] | .000 | 1.000 |
| | Wilks' Lambda | .000 | 54456.050[b] | .000 | 1.000 |
| | Hotelling's Trace | 2135.531 | 54456.050[b] | .000 | 1.000 |
| | Roy's Largest Root | 2135.531 | 54456.050[b] | .000 | 1.000 |
| Group | Pillai's Trace | .894 | 214.156[b] | .000 | .894 |
| | Wilks' Lambda | .106 | 214.156[b] | .000 | .894 |
| | Hotelling's Trace | 8.398 | 214.156[b] | .000 | .894 |
| | Roy's Largest Root | 8.398 | 214.156[b] | .000 | .894 |

Further analysis is based on differences in each factor to the dependent variable (see table 8). The results showed that there was a significant difference in values (sig. < .05), so it could be concluded that there was a significant difference in the value of environmental literacy (sig = .000) and the value of conceptual knowledge (sig = .000) between the experimental class and the control class. Based on the explanation above, it can be concluded that the application of the problem-based learning model with local wisdom (*hukum adat laôt*) oriented to socio-scientific issues in the experimental class is more effective in increasing environmental literacy and conceptual knowledge than the conventional model in the control class.

Table 8
The test result of between-subjects effects

| Source | Dependent Variable | Type III Sum of Squares | df | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | Environmental literacy | 1223.130[a] | 1 | 248.808 | .000 |
| | Knowledge concept | 1472.667[b] | 1 | 213.113 | .000 |
| Intercept | Environmental literacy | 335278.241 | 1 | 68202.065 | .000 |
| | Knowledge concept | 339864.000 | 1 | 49182.545 | .000 |
| Group | Environmental literacy | 1223.130 | 1 | 248.808 | .000 |
| | Knowledge concept | 1472.667 | 1 | 213.113 | .000 |

## DISCUSSION

As presented in Table 7, applying the problem-based learning model combined with local wisdom (hukum adat laôt) oriented to socio-scientific issues has proven effective and efficient to be applied as a learning modality. As displayed in Table 8, there is a significant difference in the average value of concept knowledge and environmental literacy based on the differences between the two learning models used. The study results revealed the effectiveness of the problem-based learning model with local wisdom (hukum adat laôt) oriented to socio-scientific issues. The local wisdom applies the principles of reflection to students to focus on real-life and complex issues to solve them through self-awareness, critical thinking, problem-solving, communicating, collaborating and independent learning (Dahliani et al., 2015; Hasanah et al., 2016; Hestiana & Rosana, 2020). This is relevant to the opinion that the problem-based learning model can present various learning solutions to improve performance and

stimulate students' motivation to identify, learn, and understand a concept (Koh & Tan, 2016; Abbey et al., 2016).

Applying the problem-based learning model with local wisdom (hukum adat laôt) is oriented to socio-scientific issues by using media and technology as an interchange to facilitate students' learning experience. The combination of media and technology is a potential learning resource that helps students resolve conflicts in real life (Fregni & Jimenez, 2020; Roh et al., 2014). In addition, the socio-scientific issue approach enables students to engage in discussions and use scientific evidence for decision-making in a socio-scientific context (Zeidler et al., 2019).

Based on the results of the study that the application of the problem-based learning model with local wisdom (hukum adat laôt) oriented to socio-scientific issues can improve students' conceptual knowledge and environmental literacy because the activities carried out by teachers and students are in accordance with the design of the model implementation activities (Altan et al., 2018). Students work together, provide motivation to complete complex tasks, provide opportunities to carry out investigations and create communication and social skills for students (Bintang et al., 2020). In addition, the subject studied as a socio-scientific issue has relevance to the concept of science as the basis of the problem, the existence of conflicts related to science, and socio-moral perspectives (Borgerding & Dagistan, 2018). It opens space for various decision-making perspectives based on one's scientific knowledge (Biology), which involves a humanistic social perspective in solving a problem.

This is supported by some research results that integrate local culture in developing a learning model that benefits students, teachers, and the communities. In general, students understand the subject matter and local cultural values contained in the area around the place of residence. Additionally, it helps increases interest and conceptual understanding (Kusdianto, 2019), improves literacy and environmental ethics (Aswita et al., 2018), fosters trust among students to form a brave and trustworthy personality (Zulfiati, 2019). Lukitasari et al., (2019) showed that applying a problem-based learning model improves critical thinking skills in social studies learning. For the social community, the integration of local culture that is carried out helps increase public understanding of the integration of culture and education (Ahmad et al., 2019). Research conducted by Putri et al., (2018), Rizkita et al., (2016), and Rubini et al., (2019) also showed that the problem-based learning model based on socio-scientific issues helps students arrange explanations about scientific phenomena, solve problems, understand concepts, improve metacognitive skills and increase scientific literacy.

Based on the research findings, the problem-based learning model combined with local wisdom (hukum adat laôt) oriented to socio-scientific issues is more effective to increase conceptual knowledge and environmental literacy in experimental class than the conventional model in the control class. The traditional model with the lecture method makes students passive (Saira et al., 2021). Students only listen and take notes on the teacher's explanations (Shakibaei et al., 2019). This method has proven ineffective for students today (Abedi et al., 2019). Meanwhile, the experimental class has the advantages to applying the socio-scientific issue approach as follows: (a) Socio-

scientific issues can improve students' scientific literacy skills compared to science, technology, society (STS) (Saunders & Rennie, 2013); (b) Socio-scientific issue plays a significant role in the contextualization of the scientific context (Subiantoro, 2017); (c) Socio-scientific issue focuses on real-life problems that can increase knowledge of science concepts and skills in students' real context (Boleng et al., 2020; Jho et al., 2014; Tideman & Nielsen, 2016) and scientific literacy (Dawson & Venville, 2013); (d) Socio-scientific issue can improve students' ability to make decisions, to be responsible and think critically (Wahyu et al., 2017; Wang et al., 2018; Marchand, 2015); (e) Socio-scientific issue fosters emotions and improves collaborative skills and the science communication process (Nicolaou, 2015). Thus, students can focus on learning, foster a sense of responsibility and creativity, develop communication skills, work collaboratively, do problem-solving activities, build positive attitudes, and promote motivation.

## CONCLUSION

Based on the findings of the study, it is concluded that the application of the problem-based learning model with local wisdom (hukum adat laôt) oriented to the socio-scientific issues becomes an effective and efficient means to be used as a learning modality with a significant score < 0.05. There was a significant difference in the value of environmental literacy (sig = .000) and the value of conceptual knowledge (sig = .000) between the experimental class and the control class, it can be seen that the application of the problem-based learning model with local wisdom (hukum adat laôt) oriented to the socio-scientific issues in the experimental class is more effective than the conventional model in the control class. Increasing students' knowledge about concepts is expected to foster literacy in students so that they grow an attitude of caring and protecting the environment. Suggestions from the results of this study are that it is necessary to prepare a problem-based learning model with local wisdom (hukum adat laôt) based LMS model because at the time of the study an obstacle was found, namely the Covid-19 pandemic so that students could access learning anywhere. The study has several limitations, it involves: (1) the implementation of learning was not optimal due to the Covid-19 pandemic, so the learning process in schools uses shift and meeting hours were also minimized; (2) the Problem-based learning model with local wisdom (hukum adat laôt) oriented to socio-scientific issues is more appropriately adapted in schools that are located in coastal areas.

## ACKNOWLEDGEMENT

The authors would like to thank the ministry of education of Indonesia for funding this research under contract: Number 134/SP2H/LT/DRPM/2021.

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